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Spontaneous Neoplasms in Fishes. II. Fibro-carcinoma-like Growth in the Stomach of *Borophryne apogon* Regan, A Deep-Sea Ceratioid Fish.

ROSS F. NIGRELLI.

New York Aquarium, New York Zoological Society.

(Plates I-IV).

Neoplastic growths in the stomach of fishes are exceptionally rare. Thomas (1931) listed the following cases recorded in the literature: fibromatosis of the cod by Bland-Sutton, 1884-1885, and Johnstone (1924); leiomyomas in various parts of the stomach, by Plehn, 1906, for the trout; Pesce, 1907, for the carp; and Williamson, 1909, for the cod.

Insofar as is known, the neoplasia described below is the first disease to be reported from these interesting deep-sea forms in which the males are parasites on the females. The fish involved was a fully grown but sexually immature female measuring 37 mm. in standard length. It was taken from the Gulf of Panama in 500 to 700 fathoms (see Beebe and Crane, 1947). Externally the belly was swollen as if filled with food, but the autopsy revealed a comparatively large, solid growth in the region of the stomach.

The normal stomach, when filled with food, was a thin-walled translucent structure. Histologically it appeared as shown in Fig. 1. The mucosa was more or less flattened, consisting of a single layer of cells and sacular glands opening into shallow pits. The submucosa consisted of a delicate layer of connective tissue containing elastic fibers, fat and blood vessels. The muscularis and serous coats were also delicately developed. If the stomach were not dilated with food the rugae would be more pronounced.

The abnormal growth was removed from the fish, sectioned in paraffin at 6 and 10 microns, and stained with iron hematoxylin, Delafield's hematoxylin-eosin, Masson's and Mallory's polychrome stains, and Giemsa's stain.

The growth strikingly resembled the fibro-carcinoma reported for human stomachs (see Ewing, 1940). Histologically, it was characterized by a tremendous overgrowth of connective tissue elements and cells of the mucosa, with stenosis occurring particularly in the pyloric region. Epithelial-like cells scattered diffusely over some areas of the

submucosa indicated that it may be a carcinoma. As in human cases of fibro-carcinoma, it was very difficult to recognize the cellular elements since they were invariably atypical.

There was no evidence of granulation or inflammatory response. The much thickened submucosa was well supplied with thick-walled blood vessels. In every section examined, the cells within these vessels were predominantly lymphocytes.

The great proliferation of mucosal cells in some regions may be noted by examination of the photomicrograph shown in Fig. 2. All the cells here appeared to be of the mucus type. Higher magnifications of these cells are shown in Figs. 3 and 4. The separation from the basement membrane seen in Fig. 3 may be due to shrinkage. However, details of the proliferating cells are best seen in Fig. 4. The nuclei may be normal or pyknotic in appearance and there was some evidence of mitosis. The cells toward the center of the lumen have undergone a great deal of degeneration but much of the abnormalities in the cytological details were probably due to improper fixation. In other regions the glandular epithelial cells predominated. Still in other areas (Fig. 5) little change was noted for this region of the stomach.

The tremendous hypertrophy of the connective tissue layers of the stomach may be seen in Figs. 2 and 5 and especially in Figs. 6 and 7. The proliferation into the muscularis (Fig. 7) was especially striking. The serous coat was also involved but there was only a slight thickening of the mesothelium.

Just how the epithelial elements infiltrated into the connective tissue layers could not be determined. Fig. 8 shows the organization of mucosal material within this region. Higher magnification of the epithelial cells and the nature of the surrounding region is clearly shown in Fig. 9. The epithelial cells have undergone considerable modifications; the nuclei were varied in size and were hyperchromatic.

The diffusion of single tumor cells with hyperchromatic nuclei into the surrounding

regions of the submucosa is shown in Fig. 10. These cells also penetrated through the muscularis into the serosa.

There was no definite evidence as to what the causative factor or factors were, but it should be pointed out that a neosporidian infection was present in the liver and surrounding tissues. Whether or not these protozoan parasites produced the stimulus initiating this growth was difficult to say. However, it is known that parasites of this group are capable of inducing tumor formation (see Nigrelli & Smith, 1938, 1940).

SUMMARY.

A fibro-carcinoma-like growth in the stomach of *Borophryne apogon* Regan, a ceratioid fish taken from the Gulf of Panama in 500 to 700 fathoms of water, is described. Histologically the neoplasia is characterized by a tremendous overgrowth of connective tissue elements and cells of the mucosa. All the coats of the stomach wall are involved. The presence of epithelial-like cells scattered diffusely over some areas of the submucosa indicate that this growth may be carcinoma similar to the fibro-carcinoma reported for human stomachs.

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EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. Photomicrograph of section of normal stomach of *Borophryne apogon*. Stained with Delafield's hematoxylin and counter-stained with eosin. 100×.
- Fig. 2. Section through the main part of the stomach. Note the tremendous proliferation of epithelial cells of the mucosa and thickened submucosa. Mallory's. 100×.

PLATE II.

- Fig. 3. Higher magnification of epithelium of the mucosa shown in Fig. 2. Delafield's hematoxylin-eosin. 675×.
- Fig. 4. Cells of the epithelium showing proliferation. Note the differences in the staining reactions of the nuclei. The cells are smaller with the neat columnar pattern lost. Great activity is indicated. Delafield's hematoxylin-eosin. 675×.
- Fig. 5. Region of the submucosa showing great proliferation of connective tissue. Very few other cellular elements are present in this area and very little is left of the mucosa. Part of the muscular coat is also shown in this section. Mallory's. 100×.
- Fig. 6. Section of the stomach near the pylorus. The epithelium is separated from the basement membrane, probably due to shrinkage. No proliferation is present within the lumen but proliferating cells are present in the region which appears to correspond to the submucosa in the normal stomach. Mallory's. 100×.

PLATE III

- Fig. 7. Region of the muscularis. Connective tissue fibers have penetrated this region and the exact pattern of the muscle fibers has been disrupted. Delafield's hematoxylin-eosin. 157×.
- Fig. 8. Section through the main body of the tumor mass. Note the extent of connective tissue and the organization of mucosal material within it. Delafield's hematoxylin-eosin. 100×.

PLATE IV.

- Fig. 9. Higher magnification showing cellular details of region seen in center of Fig. 8. Epithelial cells have undergone certain changes. In some sections the infiltration of the cells into the connective tissue is well marked. Delafield's hematoxylin-eosin. 675×.
- Fig. 10. Details showing epithelial and epithelial-like cells scattered diffusely through the submucosa. Many of the cells are atypical and it is difficult to determine whether or not they are derived from the mucosa, although the evidence strongly indicates that they are. Masson's polychrome stain. 356×.

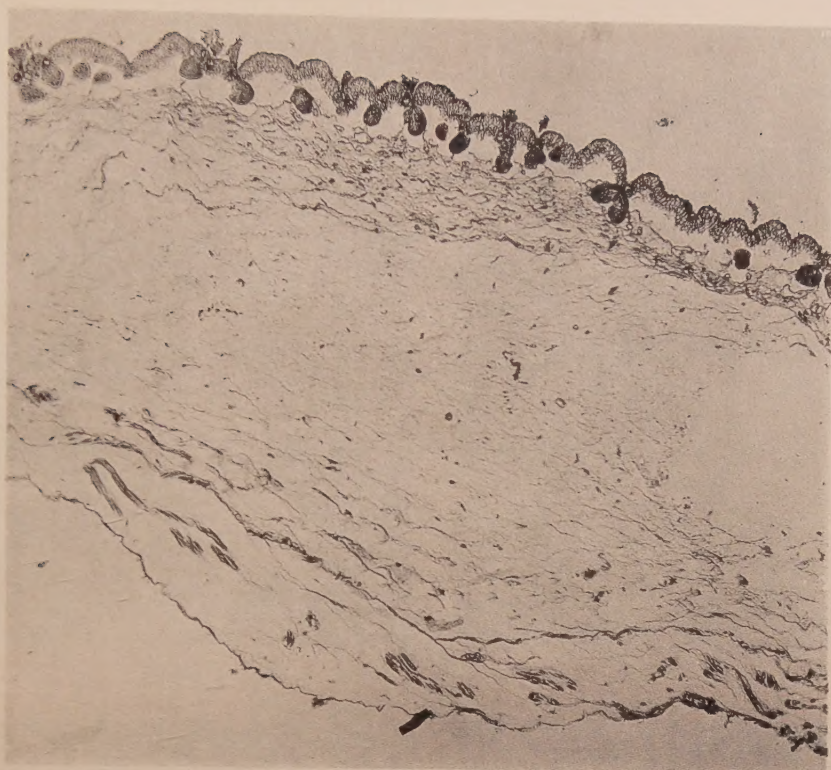


FIG. 1.

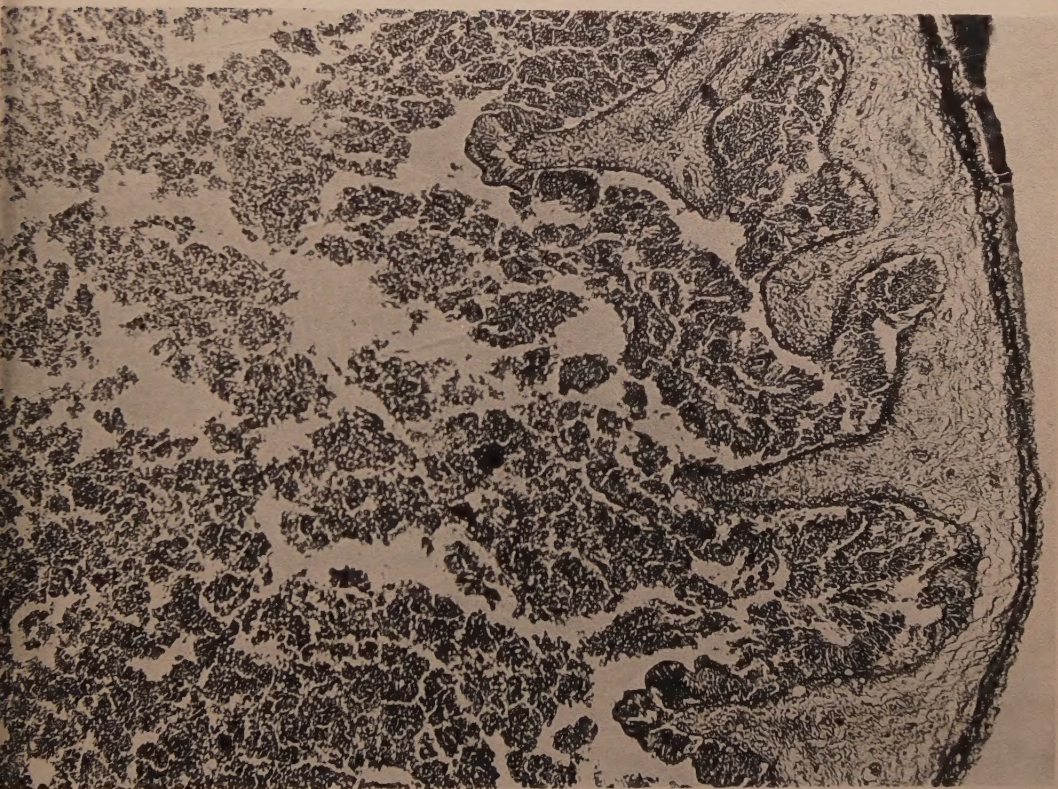


FIG. 2.

FIBRO-CARCINOMA-LIKE GROWTH IN THE STOMACH OF
BOROPHRYNE APOGON REGAN, A DEEP-SEA CERATIOID FISH.

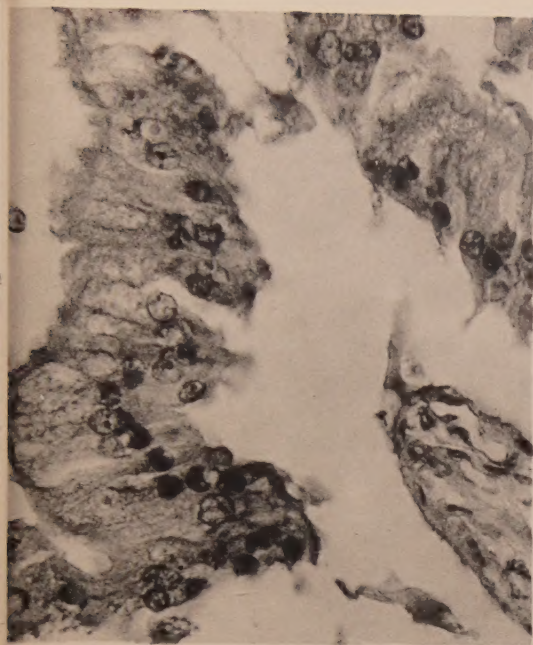


FIG. 3.

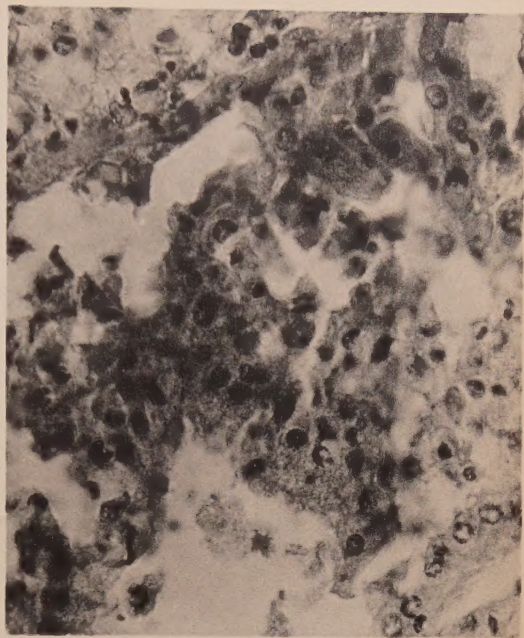


FIG. 4.

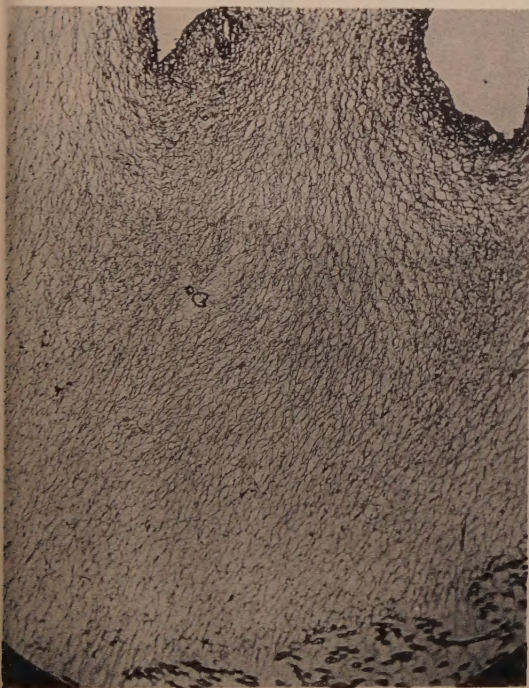


FIG. 5.

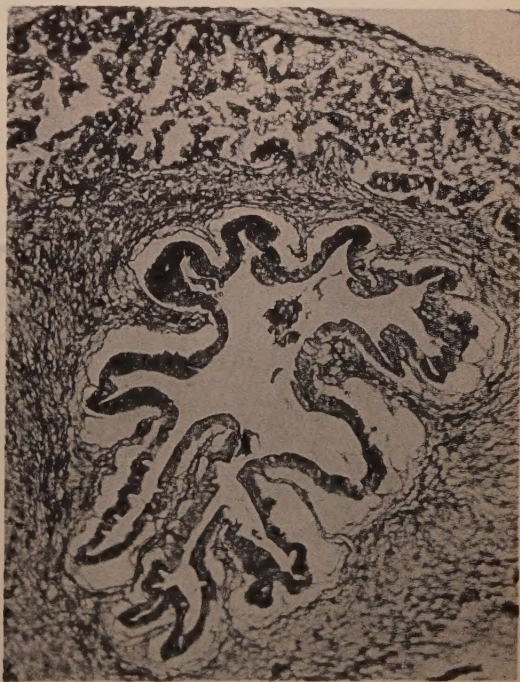
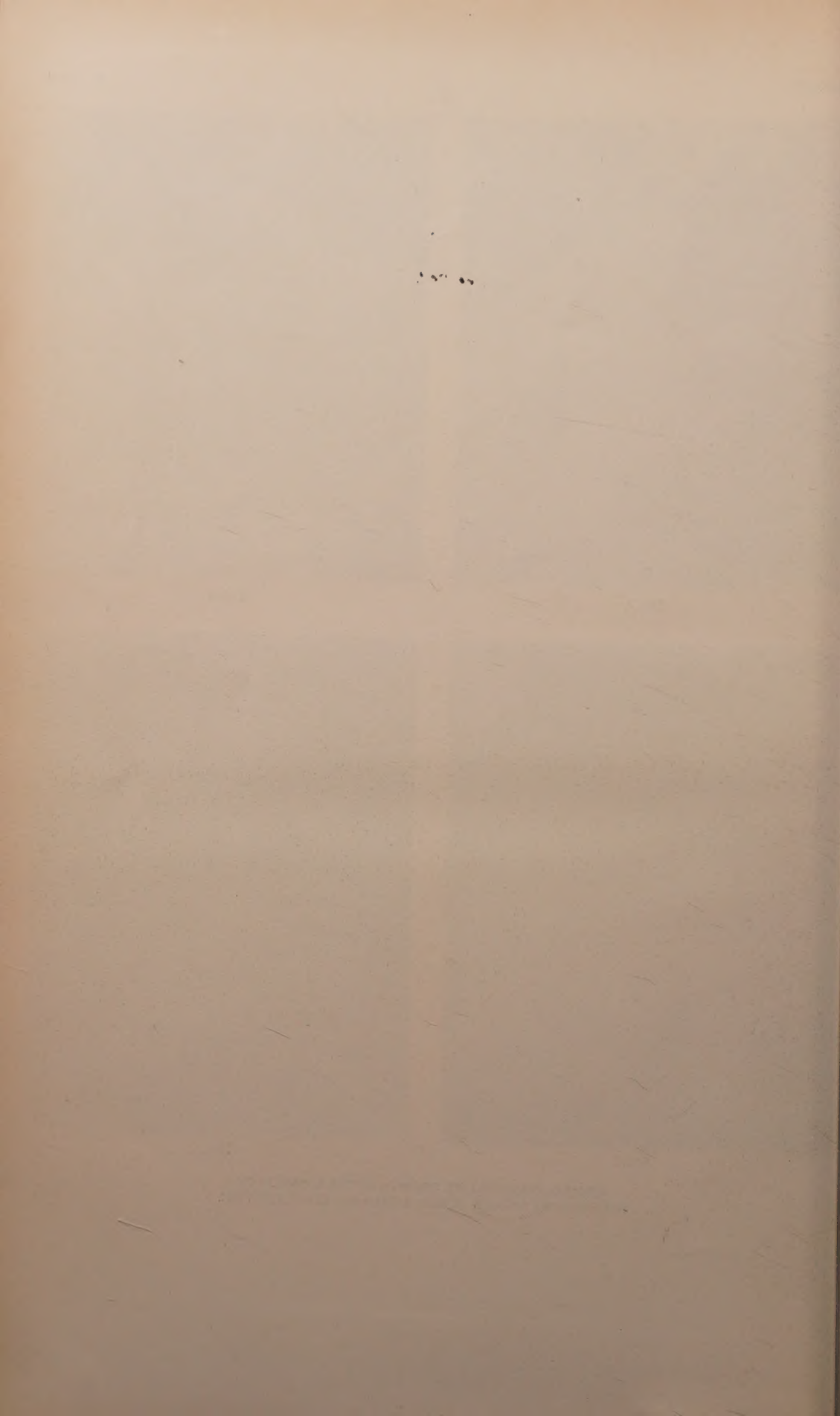


FIG. 6.

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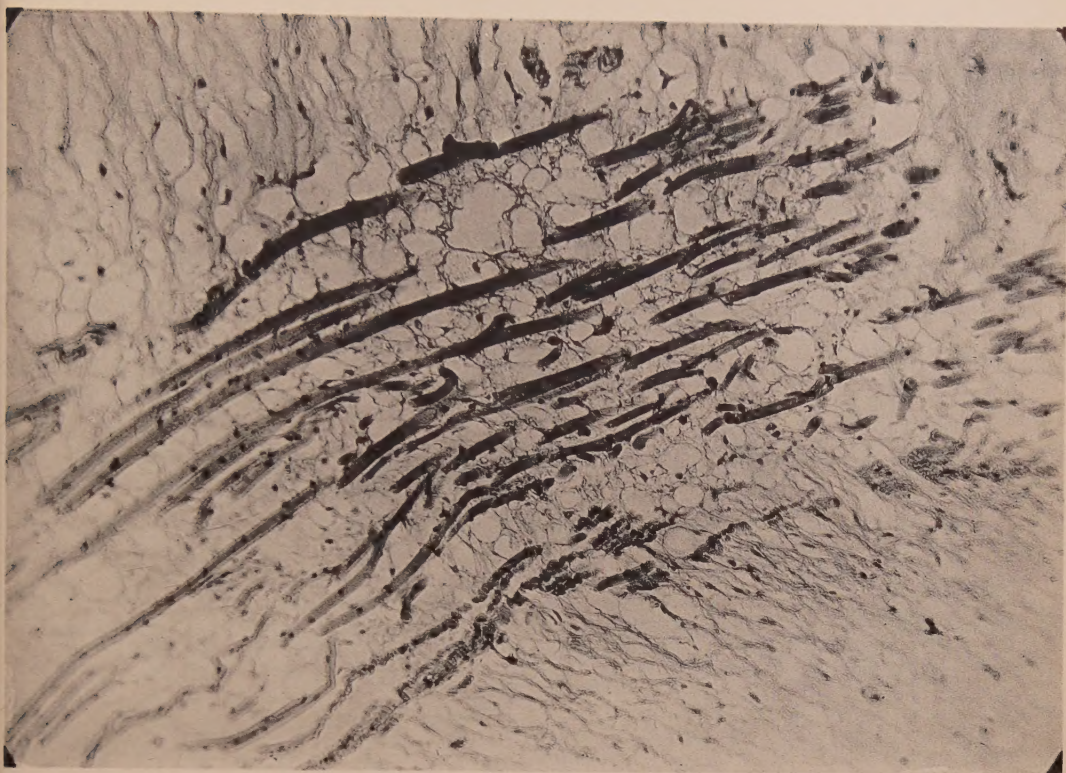


FIG. 7.

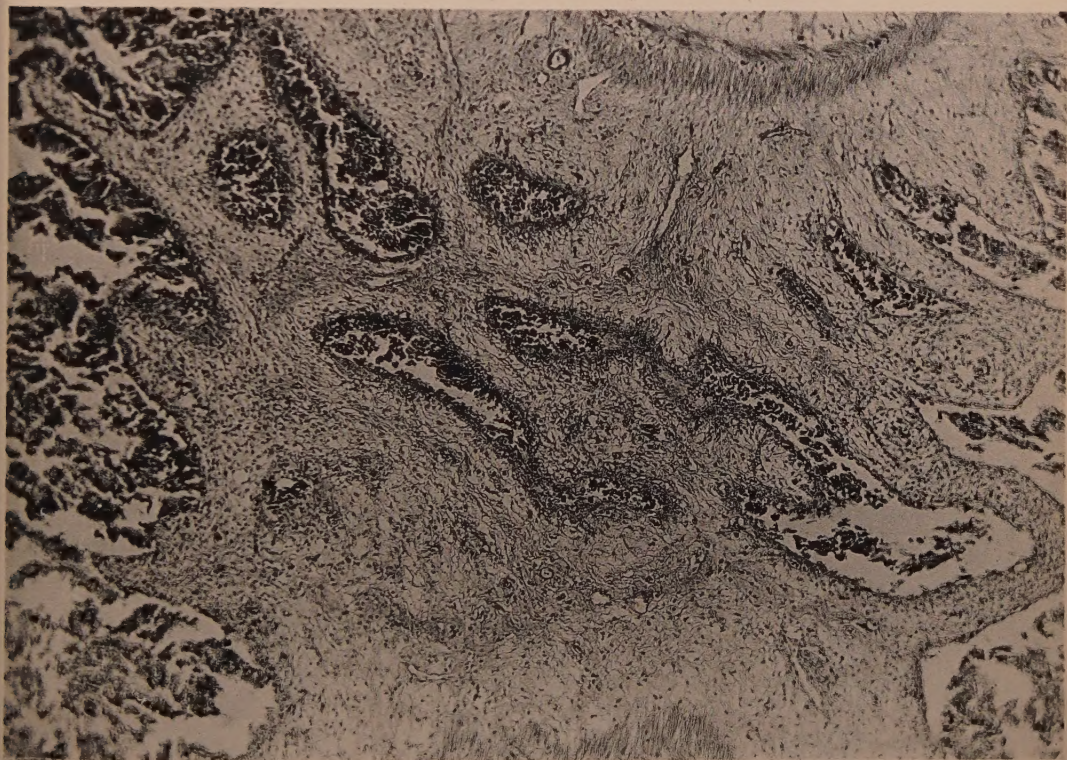


FIG. 8.

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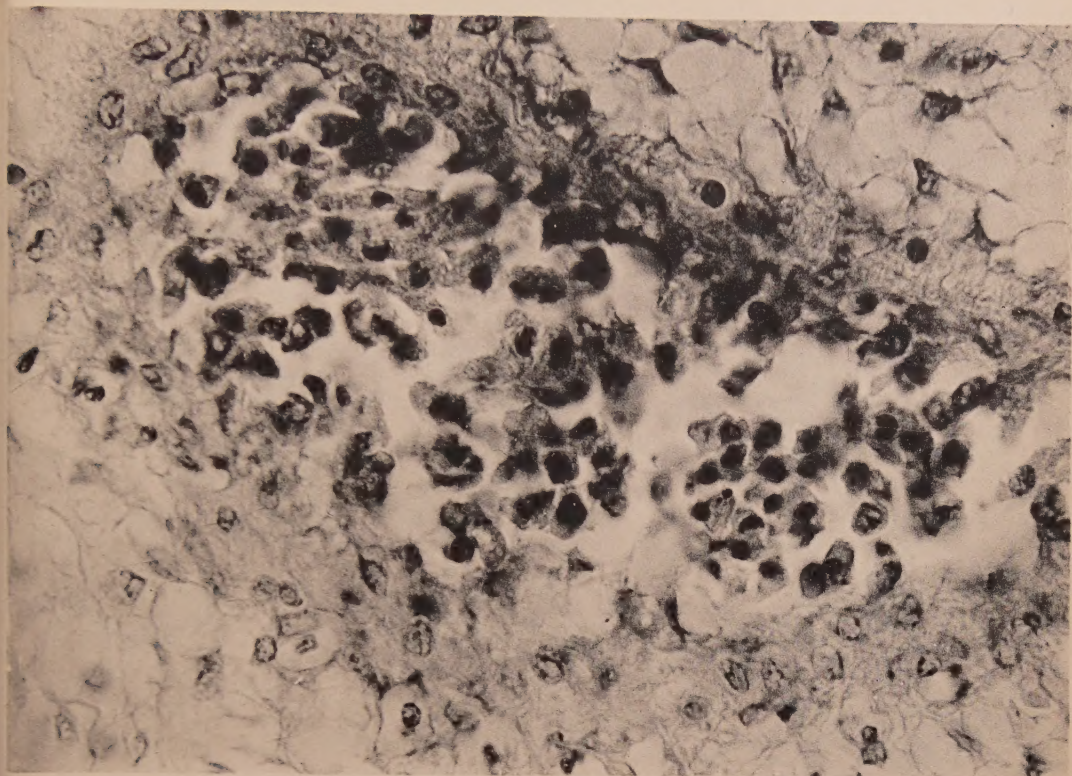


FIG. 9.

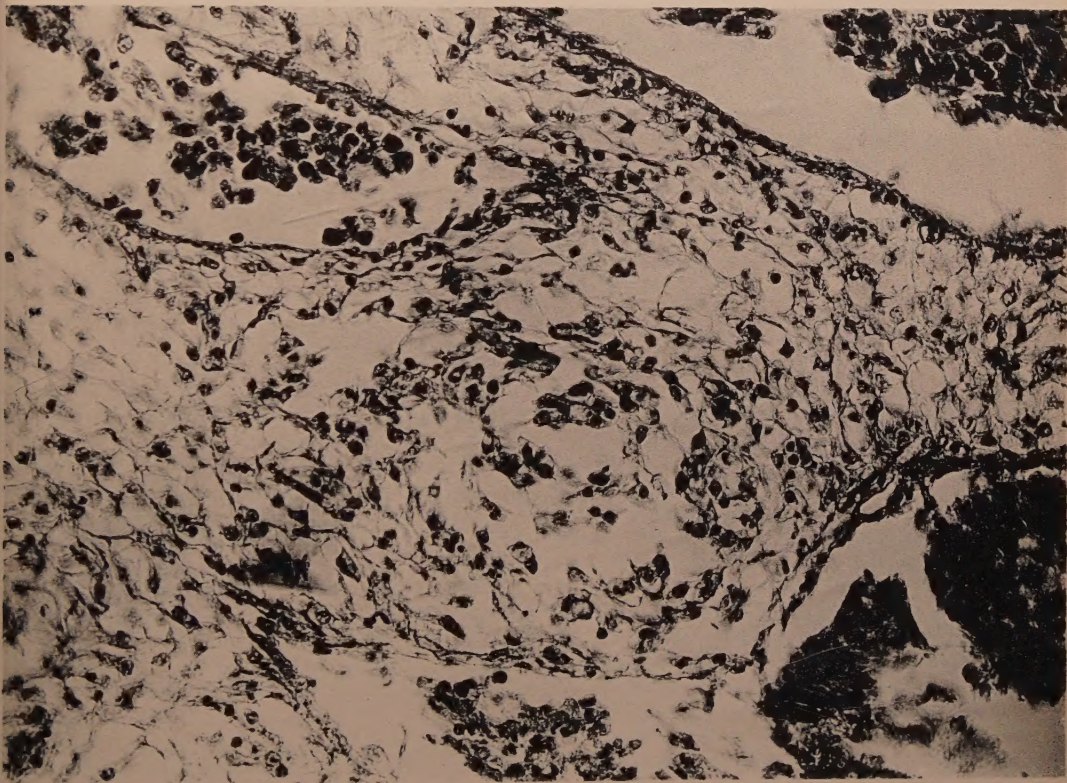


FIG. 10.

FIBRO-CARCINOMA-LIKE GROWTH IN THE STOMACH OF
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